October 21, 2002

CRUISE RESULTS

R.A.C.E. BOTTOM TRAWL SURVEY OF
EASTERN BERING SEA UPPER CONTINENTAL SLOPE
GROUNDFISH AND INVERTEBRATE RESOURCES

CHARTERED VESSEL F/V *MORNING STAR*
CRUISE 2002-02
June 5 - July 31, 2002

The Resource Assessment and Conservation Engineering (RACE) Division of the Alaska Fisheries Science Center (AFSC) recently completed a bottom trawl survey of the groundfish and invertebrate resources of the Eastern Bering Sea Upper Continental Slope (EBSUCS). This report summarizes the preliminary results of the survey.

SURVEY ITINERARY

The 57 day survey was conducted from June 5 to July 31 aboard the chartered commercial fishing vessel *Morning Star,* a 45 meter trawler. A change of crew happened in Dutch Harbor on June 14 and then again on St. Paul Island on July 8 (see Table 1 for scientific party participants and leg change dates). The vessel worked along the continental slope of the eastern Bering Sea from Akutan Island toward the northwest to the International boundary, locating randomly placed stations at depths between 200 and 1200 meters.

SURVEY OBJECTIVES

The objectives of the 2002 EBSUCS survey were to locate and successfully sample randomly placed stations throughout the slope survey area. The survey area was divided into 6 sub-areas running north to south and 5 depth strata areas distributed between 200-1200 meters. Fishing effort was distributed within each sub-area and depth stratum based on the total surface area of the sample area (Table 2). The catch of each successful haul was processed and subsequently recorded via onboard databases. The primary goals of the survey were to:

1. locate and successfully trawl random locations on a variety of slope habitats;

2. describe the composition, spatial and depth distribution, and relative abundance of groundfish and invertebrate resources of the EBSUCS;

3. collect biological data, including sexed lengths, otoliths, individual weights, stomachs, tissue samples, museum specimens, and digital photographs, from a variety of commercially and ecologically important species, and;

4. collect environmental parameters such as depth, bottom type, water temperatures and sea states to relate changes in fish and invertebrate distribution among years to changes in oceanographic conditions.

SURVEY DESIGN

The 2002 Eastern Bering Sea Upper Continental Slope survey was designed to sample the entire upper slope region from 200-1200 meters using a stratified random design. The goal was to distribute sampling effort in proportion to the survey surface area by depth and sub-area. The survey area was divided into 6 physical sub-areas running south to north (1-6, Figure 1) that may represent distinct biological realms such as canyon areas (2, 4), steep rough slope areas (3,5) and broad gentle sloping areas (1, 6). Each sub-area was then divided into five depth strata each covering approximately 200 meters in depth from 200-1200 meters. Table 2 shows the five depth strata, target depth ranges for each stratum, and the surface area and percentage each depth stratum represented.

SURVEY VESSEL AND METHODS

The *F/V Morning Star* is 45 m long and powered by a single main engine developing 1,710 continuous horsepower. The vessel is equipped with a full suite of modern navigation, fish-finding, and communication electronics. An experienced skipper and four-member fishing crew operated the vessel and the fishing gear, while a team of six scientists collected data and specimens from the trawl samples.

The RACE Division provided standardized trawls, bridles, and trawl doors for the survey. A standardized Poly Nor'Eastern high opening bottom trawl equipped with mud-sweep roller gear was used to sample all stations. This sampling trawl has a 27.2 m headrope with twenty-one 30 cm floats and a 24.3 m long-link chain fishing line attached to a 24.9 m footrope. The body of the net was constructed of 127 mm stretched-mesh polyethylene netting, with 89 mm stretched-mesh polyethylene netting in the codend, and a 32 mm stretched-mesh nylon codend liner. The mud-sweep roller gear was constructed of 203 mm solid rubber disks strung over 16 mm high tensile chain. The net was fished with 1.83×2.75 m (6×9 ft) steel V-doors rigged with four-point bridles to enhance their stability at slow towing speeds and 55-m bridles between the doors and wingtips. This trawl is similar to the standard trawl historically used for the RACE Division, West Coast Upper Continental Slope survey. The fishing dimensions of the trawl were measured using a Scanmar[1] net measurement system.

Sea surface temperatures were collected with conventional bucket thermometers, while a net-mounted SeaBird (SBE-39) data logger to collect surface-to-bottom temperature-depth profiles. A continuous track of the vessel's GPS position during searching and transit operations (observations every 30-40 seconds) was recorded. More detailed position tracks (observations every 6 seconds) were collected during all fishing operations. An attempt was made to perform a 30 minute tow at a constant fishing speed of 2.5 knots with the trawl as close to its equilibrium fishing speed and configuration as possible when the footrope made bottom contact at each station. Electronic bottom contact sensors (BCS) were hung from the footrope of the trawl to detect when the trawl was on bottom and monitor the actual duration that the trawl remained in contact with the seabed. Synchronized data streams from the GPS, BCS, Scanmar net mensuration system, and SeaBird data loggers were synthesized into a data set that described and quantified the sampling effort for each

[1]Reference to trade names or commercial firms does not constitute U.S. government endorsement.

haul. This data set included precise measurements of distance fished, fishing dimensions (width and height) of the net, bottom depth, water temperature, and bottom contact. All electronic data were synthesized after each haul and scrutinized by the lead scientist to determine the quality of the haul before processing the catch and moving to the next station.

The entire contents of every successful tow was processed using standardized RACE catch procedures for groundfish surveys. Catches were sorted by species and each species weighed separately (occasionally invertebrates that were too difficult to identify as distinct were weighed and recorded collectively). A sub-sample (100-250 fish) of most fish species (see Table 3) were randomly selected for further biological data collection including sexed lengths, otoliths, individual weights, and stomachs. Specimens were also collected from many species for more detailed studies of their biology (tissue samples, ovaries, etc) or as whole body specimens of fish and invertebrates that were rare, possibly undescribed, or of systematic interest.

RESULTS

One-hundred-fifty-six tows were attempted during the survey and were distributed by area and depth along the slope region (Figure 1). One-hundred-forty-one tows were completed successfully and were used for biological assessments while 15 tows were unsatisfactory or incomplete due to the net coming off bottom during the tow, the net severely damaged during towing, or the net not achieving the proper fishing configuration during the tow due to bottom type or current. Table 2 shows the number of tows completed in each depth strata and the minimum and maximum depths towed within each strata. A comparison of the survey area percentage by depth strata and the number of hauls successfully completed in each depth strata (Table 2) shows that the survey goals were met for strata 1-4. In the deepest strata (1000-1200 m) only 11 tows or 7.8% of the tows were completed where a minimum of 17 tows were required to achieve the 12.27 % goal. This lack of sufficient tows in strata 5 is due to the difficulty in locating trawlable bottom because of steeper contours and rougher bottom types.

Approximately 147 fish species and 240 invertebrate species were identified. However the actual numbers may be slightly higher or lower due to grouping unidentified specimens into a common category or recording a single species as two separate species when identifications were dubious.

Table 3 shows 50 fish species in order of highest biomass for which we collected biological data. These 50 species accounted for 99.8% of the total fish biomass encountered with the remaining 0.2% representing mostly pelagic fishes such as lantern fishes, angler fish, unidentified eelpouts, and snailfish species. Biological data collected included 51,314 sexed length measurements, 3,822 otoliths, 4,458 individual weights, 2,583 stomach samples, more than 441 fish and invertebrate whole voucher specimens and 1693 digital photos. Sexed lengths will be used to develop size composition length frequencies for each species by area or depth strata. Otoliths collected will be used to age many of the commercially important species and those of large biomass species that are of ecological importance. Stomach samples collected will be analyzed for trophic level interactions between species in the slope community. Individual weights will be used to add to a growing data base of the length-weight relationships used as data checks on a haul by haul basis. Voucher specimens will be used for systematic studies and record verifications and the majority will subsequently be housed at the University of Washington Fish Collection in Seattle, Washington or the California Academy of Sciences in San Francisco, California. The digital photos collected will be catalogued and added to the data base of survey photos that are used for presentations, training, field identification guides, systematic studies and public outreach.

Table 4 shows 19 major groups of invertebrates caught in 2002 and the summed biomass and

number of individuals of each group. The summed biomass of the 19 groups accounted for 99.9% of the invertebrate total biomass caught on the survey. The number of species included in each group varies from possibly a single species, such as the sea mouse, to large groups, such as the sea stars, and snails and clams which included more than 40 species in each group. The invertebrate biomass total for the survey was 9,142.127 kilograms which is approximately 6% of the total survey biomass, however invertebrates accounted for 62% of the species diversity.

Table 1.--Vessel itinerary and scientists participating during the 2002 NMFS Eastern Bering Sea Upper Continental Slope survey of fish and invertebrate resources.

Leg 1: 6/5 - 6/14

Bob Lauth	Field Party Chief	AFSC, Seattle
Gerald Hoff	Fishery Biologist	AFSC, Seattle
Duane Stevenson	Fishery Biologist	AFSC, Seattle
James Orr	Fishery Biologist	AFSC, Seattle
Dana Hanselman	Fishery Biologist	AFSC, Juneau
Jon Short	Fishery Biologist	AFSC, Seattle

Leg 2: 6/14 - 7/8

Gerald Hoff	Field Party Chief	AFSC, Seattle
Lyle Britt	Fishery Biologist	AFSC, Seattle
Rebecca Rueter	Fishery Biologist	AFSC, Seattle
Sarah Gaichas	Fishery Biologist	AFSC, Seattle
David Ebert	Fishery Biologist	AFSC, Seattle
Mei-Sun Yang	Fishery Biologist	AFSC, Seattle

Leg 3: 7/8 - 7/31

Lyle Britt	Field Party Chief	AFSC, Seattle
Duane Stevenson	Fishery Biologist	AFSC, Seattle
Stan Kotwicki	Fishery Biologist	AFSC, Seattle
Beth Matta	Fishery Biologist	AFSC, Seattle
Josh Keaton	Fishery Biologist	AFSC, Seattle
Irina Benson	Fishery Biologist	AFSC, Seattle

For further information, contact: Dr. Gary Stauffer, Director, Resource Assessment and Conservation Engineering Division, Alaska Fisheries Science Center, National Marine Fisheries Service, 7600 Sand Point Way NE, Bldg. 4, Seattle, WA, 98115-0070. Telephone (206)526-4170.

Table 2. Results of towing depth distributions from the 2002 Eastern Bering Sea Upper Continental Slope Survey. Depth strata designations (1-5), target depths and the actual depth range of tows; the number of tows completed in each stratum, and the towing effort in comparison to strata areas.

Depth Strata	Target Depth Range (m)	Bottom Depth (m)		Completed Tows	Strata Survey Area (km2)	Entire Survey Area (%)	Entire Survey Tows (%)
		Min	Max				
1	200-400	204	368	45	10,329.60	31.32	31.91
2	400-600	400	578	36	8,515.78	25.82	25.53
3	600-800	607	799	29	5,548.59	16.82	20.57
4	800-1,000	814	998	20	4,544.58	13.78	14.18
5	1,000-1,200	1,018	1,200	11	4,047.06	12.27	7.80

Table 3. All fish species where biological data was collected in rank order by weight caught during the 2002 Eastern Bering Sea Upper Continental Slope Survey. Included are the numbers and types of biological data recorded or collected.

Scientific Name	Common Name	Total Weight (kg)	Individuals Caught (#)	Individuals Measured (#)	Otoliths Collected (#)	Individual Weights (#)	Stomachs Collected (#)
Albatrossia pectoralis	giant grenadier	81,535	23,169	8,175	792	792	394
Sebastes alutus	Pacific ocean perch	12,964	15,816	2,040	303	303	
Coryphaenoides cinereus	popeye grenadier	9,208	63,549	7,302			
Atheresthes stomias	arrowtooth flounder	7,615	6,283	3,565	487	487	302[A]
Somniosus pacificus	Pacific sleeper shark	5,585	148	141		51	
Bathyraja parmifera	Alaska skate	4,752	804	802		72	
Reinhardtius hippoglossoides	Greenland turbot	4,440	1,091	1,076	488	488	229
Hippoglossoides elassodon	flathead sole	3,829	9,111	3,987			
Theragra chalcogramma	walleye polock	3,114	2,330	1,675			450
Sebastolobus alascanus	shortspine thornyhead	3,064	5,392	3,709	883	883	242
Bathyraja aleutica	Aleutian skate	3,028	1,267	1,178		198	522[B]
Atheresthes evermanni	Kamchatka flounder	2,991	1,679	1,613	614	614	
Anoplopoma fimbria	sablefish	2,607	968	917			244
Bothrocara brunneum	twoline eelpout	2,093	3,220	2,368		78	
Glyptocephalus zachirus	rex sole	1,417	3,339	2,640			
Hippoglossus stenolepis	Pacific halibut	1,256	101	101			
Gadus macrocephalus	Pacific cod	1,214	479	468			200
Sebastes borealis	shortraker rockfish	826	237	236	171	171	
Bathyraja lindbergi	Commander skate	708	399	366		26	
Bathyraja maculata	whiteblotched skate	594	188	186		27	
Lycodes concolor	ebony eelpout	489	691	541	279	279	
Bathyraja interrupta	Bering skate	463	363	355		50	
Coryphaenoides acrolepis	Pacific grenadier	431	1,789	1,477			
Hemitripterus bolini	bigmouth sculpin	309	125	121	106	106	
Bathyraja trachura	roughtail skate	308	196	164		31	
Psychrolutes phrictus	blob sculpin	301	105	96		30	

Table 3 continued…

Scientific Name	Common Name	Total Weight (kg)	Individuals Caught (#)	Individuals Measured (#)	Otoliths Collected (#)	Individual Weights (#)	Stomachs Collected (#)
Bathyraja minispinosa	whitebrow skate	251	190	185		11	
Malacocottus zonurus	darkfin sculpin	226	2,149	1,471	241	241	
Dasycottus setiger	spinyhead sculpin	189	1,472	1,336			
Bathyraja taranetzi	mud skate	148	176	160		21	
Careproctus melanurus	blacktail snailfish	145	242	232	146	146	
Careproctus furcellus	emarginate snailfish	108	126	16			
Sebastes aleutianus	rougheye rockfish	89	121	119	104	104	
Zaprora silenus	prowfish	58	13	12			
Lycodes diapterus	black eelpout	50	956	810			
Embassichthys bathybius	deepsea sole	27	28	20			
Antimora microlepis	Pacific flatnose	25	104	96		40	
Lepidopsetta polyxystra	northern rock sole	24	50	50			
Icelus canaliculatus	blacknose sculpin	19	1,077	212			
Aptocyclus ventricosus	smooth lumpsucker	16	30	26			
Microstomus pacificus	Dover sole	15	21	21			
Bathyagonus nigripinnis	blackfin poacher	15	1,269	1,223			
Oncorhynchus keta	chum salmon	11	7	5			
Bathyraja violacea	Okhotsk skate	9	3	3		1	
Sebastes polyspinis	northern rockfish	6	8	8			
Raja badia	roughshoulder skate	5	2	1			
Lycenchelys crotalinus	snakehead eelpout	5	51	2			
Sebastes ciliatus	light dusky rockfish	4	3	3			
Sebastolobus altivelus	longspine thornyhead	1	3	3			
Pleurogrammus monopterygius	Atka mackerel	1	2	1			
TOTALS		**156,588**	**150,942**	**51,314**	**3,822**	**4,458**	**2,583**
[A]Represents both arrowtooth flounder and Kamchatka flounder stomachs combined.							
[B]Represents all skate stomachs taken collectively.							

Table 4. Invertebrate groups, total weight, and number of individuals caught during the 2002 Eastern Bering Sea Upper Continetal Slope Survey.

Common Group Name	Total Weight (kg)	Individuals Caught (#)
tanner, king, lyre crabs	2,797	29,068
sea stars	1,441	114,201
sponges	1,239	
sea anemones	690	8,975
sea cucumbers	583	5,290
squid and octopus	376	1,083
bryozoans	376	
tunicates	337	
snails and clams	317	7,063
worm tubes	300	
shrimps	223	35,875
jellyfishes	181	344
sea biscuits & urchins	82	6,049
corals and sea whips	67	4,661
hermit crabs with shells	50	1,474
sea mouse	38	2,863
empty shells	22	
snail eggs	7	
sea slugs	3	47
Totals	**9,129**	**216,993**

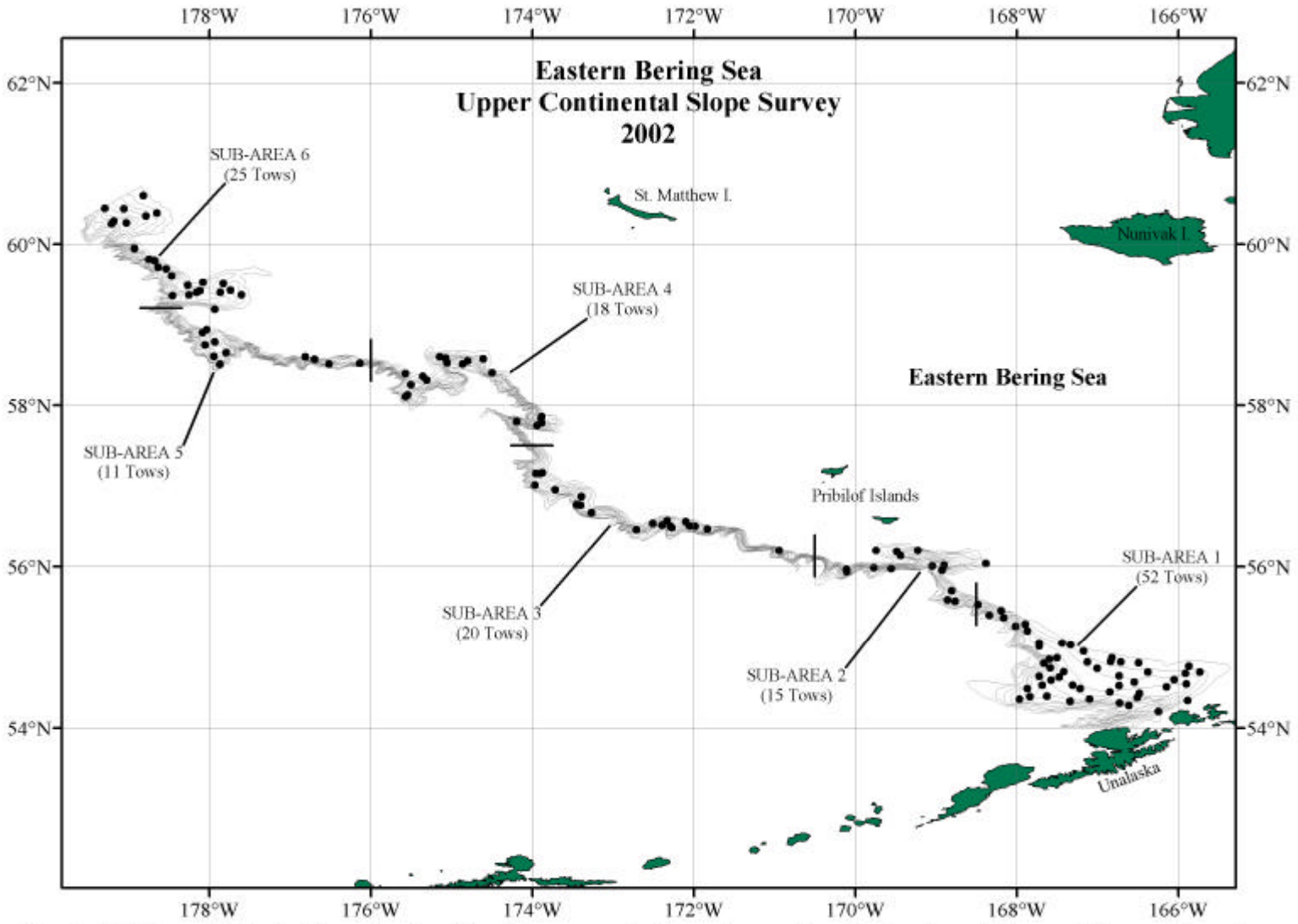

Figure 1. 2002 Eastern Bering Sea Upper Continetal Slope Survey area. Includes sub-areas 1-6 and the locations of all successful tows within each sub-area designated by black dots.